

For Future Times and Beings

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MASTER - 1/30/78

FOR FUTURE TIMES AND BEINGS

"I had monuments made of bronze, lapis lazuli, alabaster . . . and white limestone . . . and inscriptions on baked clay . . . I deposited them in the foundations and left them for future times."

-- Esarhaddon, King of Assyria  
Seventh Century, B. C.

In 1939,  
before my fifth birthday, my parents took me to the ~~1939~~ New York World's Fair, ~~which~~ <sup>It</sup> exhibited wonders. Lightning was made to crackle, blue and fearsome, between two metal spheres. A sign said "Hear light! See sound!" and it turned out that, sure enough, such things were possible. There were buildings devoted to strange cultures and faraway lands, <sup>of very</sup> whose existence I had been totally ignorant ~~of~~. The centerpiece of that World's Fair was the Trylon and Perisphere, a ~~graceful~~ <sup>stately</sup>, tapering tower and a building-sized sphere ~~in~~ in which was something called "The World of Tomorrow." You ~~would walk~~ <sup>high-railed</sup> on a ramp and below you, in miniature, was an exquisitely detailed model of the future -- graceful aerial skyways filled with streamlined automobiles and happy citizens purposefully intent on some futuristic business, the nature of which was difficult to divine from the perspective of my limited experience and abbreviated stature. But one message was clearly communicated: there were other cultures and there would be future times.

The confidence in the future evinced by ~~the 1939~~<sup>that</sup> World's Fair was dramatically illustrated by the Time Capsule, a chamber "hermetically sealed," filled with newspapers, books and artifacts of 1939, buried in Flushing Meadows to be opened and revealed automatically in some distant epoch. Why? Because the future would be different from the present. Because those in the future would want to know about our time, as we are curious about our antecedents. Because there was something graceful and very human in the gesture, hands across the centuries, an embrace of our descendants and our posterity.

There have been many time capsules both before and since. Esarhaddon, son of Sennacherib, was a mighty general and an able administrator, but he also had a conscious interest in presenting not just his military glory but his entire civilization to the future, burying cuneiform inscriptions in the foundation stones of monuments and other buildings. Esarhaddon was king of Assyria, Babylonia and Egypt. His military campaigns extended from the mountains of Armenia to the deserts of Arabia. For all that, his name is hardly a household word<sup>today</sup>, but his works have made a significant contribution to our knowledge of the Middle East in the seventh century B.C. His son and successor, Assurbanipal, perhaps influenced by the time-capsule tradition of his father, accumulated a massive library on stone tablets comprising the knowledge of all that was known in that remote epoch. The remains of Assurbanipal's library are a remarkable resource for scholars of today. Esarhaddon and Assurbanipal have spoken clearly down through the centuries and millenia. For those



who have done something they consider worthwhile, communication to the future is an almost irresistible temptation, and it has been attempted in virtually every human culture. In the best of cases it is an optimistic and far-seeing act; it expresses great hope about the future; it time-binds the human community; it gives us a perspective on the significance of our own actions <sup>at this moment in the long historical journey</sup> ~~in the long historical perspective~~ of our species.

The coming of the space age has brought with it an interest in communication over time intervals far longer than any Esarhaddon could have imagined, as well as the means to <sup>send messages to the distant future.</sup> ~~carry out such communication.~~ We have <sup>gradually</sup> ~~slowly~~ realized that we humans are only a few million years old on a planet a thousand times older. Our modern technical civilization is one ten-thousandth as old as mankind. What we know well has lasted no longer than the blink of an eyelash in the <sup>enterprise</sup> ~~perspective~~ of cosmic time. Our epoch is not the first or the best. Events are <sup>occurring at a</sup> ~~careening down the~~ <sup>less</sup> ~~breathtaking~~ corridors of time at a pace and no one knows what tomorrow will bring -- whether our present civilization will survive the perils <sup>that</sup> ~~which~~ <sup>and be transformed,</sup> ~~face us~~ or whether in the next century or two we will destroy <sup>our technological society,</sup> ~~ourselves.~~ But in either case it is <sup>will not be</sup> ~~not~~ the end of the human species.

There will be other men and other civilizations and they will be different from us. Our civilization is the product of a particular path our ancestors have <sup>followed</sup> ~~went~~ <sup>among</sup> ~~through~~ the vagaries of historical alternatives. Had events of the distant past taken a slightly different turn, our surroundings and thought processes, what we find natural and hold dear, might be very different. Despite our everyday sense that things should,

Amie: a lot to be changed here?

of course, be the way they are, the details of our particular civilization are extraordinarily unlikely, and it is easy to imagine a set of historical events which would have led to a <sup>rather</sup> very different civilization -- for example, Constantine was converted to Mithraism after the Battle of the Milvian Bridge and one in which <sup>a subsequent</sup> an intellectual revolt against institutionalized Mithraism led to a Renaissance, <sup>still</sup> and in which bulls and scorpions were dominant cultural motifs. Citizens of such a civilization would, ~~of course~~, consider it to be perfectly ordinary and reasonable and a civilization like ours the merest historical romancing. This lack of historical determinism in the details of a civilization means that those details are of extraordinary value, not just to professional historians but to all who wish to understand the nature of <sup>a culture</sup> ~~human beings and their cultures~~. I think it is this respect for the integuments of <sup>a</sup> civilization <sup>that</sup> ~~which~~, above all other reasons, makes us sympathetic to the enterprise of time capsuling.

But ~~the~~ Earth is ~~not the only place~~. It is <sup>only one</sup> ~~one~~ small planet among nine or so <sup>that</sup> ~~which~~ endlessly circle our star, the Sun; and the Sun is but one of some 250 billion stars <sup>that</sup> ~~which~~ make up a great, whirling pinwheel of gas and dust and stars called the Milky Way <sup>galaxy</sup>. In turn, the Milky Way is one of perhaps hundreds of billions of other galaxies. While we are still profoundly ignorant about many of the details, there is evidence that planets are a common accompaniment of stars and that the chemical steps <sup>that</sup> ~~which~~ led to the origin of life on Earth some four billion years ago require only the most common cosmic conditions.

Many scientists therefore now think it likely -- although it is by no means guaranteed -- that innumerable other planets have seen the origin of simple forms of life, their slow evolution into more complex forms, the development of beings with some degree of intelligence and ability to manipulate the environment: and eventually the emergence of a technological civilization. The creatures on such other planets would be astonishingly different from human beings or any other creatures ~~which~~ <sup>that</sup> inhabit our little planetary home, the Earth. ~~Just~~ <sup>set</sup> like history, evolution proceeds in a multitude of small and unpredictable steps, the variation in any one of which might produce profound differences later on. Beings elsewhere might think as well as we do or better; they might be better poets or engineers or philosophers: they might have superior moral or aesthetic standards: but they will not be human beings or anything even close. Likewise, the details <sup>and integuments</sup> of their civilizations, constructed by beings profoundly different to begin with, on an alien planet with a different environment and different lifestyles required for survival, should be far stranger than any proposition <sup>we have</sup> posed in space fantasy or science fiction.

And yet there is an argument -- perhaps it is only a hope -- that we might be able to communicate with representatives of such exotic civilizations, because they, like we, must come to grips with the same laws of physics and chemistry and astronomy. The composition of a star and its spectral properties are not fundamentally impositions ~~which~~ <sup>that</sup> scientists have made on nature, but rather the other way around. There is an external reality ~~which~~ <sup>that</sup> we ignore at our peril, and indeed much of the evolution of the human species can be described as an increasing concordance between the images within our brains and the reality in the external world.



Thus, whatever the differences in starting points, there must come to be a gradual convergence in intellectual content and discipline between diverse planetary species.

So if it is possible to communicate we think we know what the first communications will be about: They will be about the one thing ~~which~~ the two civilizations are guaranteed to share in common, and that is science. The greatest interest might be in communicating information on music, say, or social conventions; but the first successful communications will, in fact, be scientific. <sup>II</sup> And how might such communication be effected? Space vehicles travel very slowly. A typical mission to the moon lasts a few days, to the nearby planets a few months, to the outer solar system a few years. We do not expect other civilizations among the ~~other~~ planets in the <sup>S</sup>un's family. Even quite optimistic estimates place the nearest civilization at a few hundred light years, where a light year is almost six trillion miles. It would take our present spacecraft some tens of thousands of years to go the distance of the nearest star and several tens of millions of years to travel this estimated distance to the nearest <sup>other</sup> civilization.

A much quicker and more reliable means of interstellar communication is to send or receive radio messages <sup>that</sup> ~~which~~ travel at the speed of light. Our present radio technology is fully adequate for this purpose and several attempts have been made to listen to a few hundred nearby stars and galaxies for possible intelligent signals, but so far without positive results. There are so many stars and we have so little

information about which are the likely candidates that it would be astonishing if the very first efforts were rewarded with success. A long-term effort of a few dedicated radio telescopes occupying at least some decades is required. Only one attempt has been made by radio astronomers to send a message into space. This occurred in November, 1974, at the dedication of the resurfacing of the great Arecibo radio telescope in Puerto Rico, and was ~~done~~ not so much ~~as~~ a serious effort at interstellar communication as a demonstration of the great powers <sup>that</sup> ~~which~~ radio technology <sup>has</sup> ~~now~~ puts at our command. *It is described further in Chapter —.*

There is a major difference between sending and receiving. We have only recently achieved the capability of doing either and any civilization even a little bit behind us technologically could do neither. Therefore, a baby civilization like ourselves is not <sup>a</sup> ~~the~~ civilization <sup>that</sup> ~~which~~ might be expected to transmit; the technology of any other communicative civilization should be far in advance of our own. In addition, the immense distances between the stars means that it would be a very long time -- probably many hundreds of years -- before any signal ~~which~~ we transmit <sup>could</sup> ~~might~~ be answered by a civilization on a planet of some other star. As a practical means of instituting interstellar dialogue, neither radio signals nor interstellar spacecraft is appropriate, and we must instead concentrate on the receipt of monologues from elsewhere. The primary approach quite properly is the search for radio messages transmitted (by more advanced civilizations in our direction).



But it is hard to resist sending out something ourselves. Most interplanetary spacecraft will pass by the target planet and remain in a long, looping trajectory around the sun, to become ~~an~~ artificial planets of the solar system. Others will orbit or land on the target planet. But occasionally ~~there is~~ <sup>is</sup> a kind of game of interplanetary billiards ~~which~~ occurs, in which the gravity of one planet is used to assist the spacecraft in a short-time fast trajectory to another, more distant ~~planet~~ <sup>world.</sup> The first such missions, by the Pioneer 10 and 11 spacecraft, were launched in 1971 and 1972 to examine Jupiter. The Jupiter swing-by accelerated Pioneer 11 so that it ~~will fly~~ <sup>flies</sup> by Saturn in 1979. But the close passage by Jupiter for both Pioneers 10 and 11 results in an extraordinary flight path: they are now ~~irrevocably~~ <sup>irrevocably</sup> set on ~~a~~ <sup>ies that</sup> trajectory ~~which~~ will take them out of the solar system. Pioneers 10 and 11 are mankind's first interstellar probes. The characteristic speeds of such spacecraft are about 10 kilometers per second with respect to the Earth. They therefore travel <sup>about</sup> one astronomical unit, the distance between the Earth and the sun, ~~about~~ every six months. They take two and a half years to go to Jupiter, five ~~years~~ to Saturn, 15 ~~years~~ to Neptune, 20 ~~years~~ to Pluto, <sup>and</sup> more than ten thousand years to the belt of dead cometary husks ~~which~~ <sup>that</sup> slowly orbit the sun in the dark of the outer solar system, ~~where the sun appears as a~~ <sup>point of light</sup>. It is only then that they enter the realm of the stars.

The radio transmitters of Pioneers 10 and 11 will be dead long before they ~~will have~~ <sup>have</sup> reached even the orbit of Pluto, much less the distance to the nearest star. They are condemned to wander passively

and forever<sup>in</sup> the depths of interstellar space. Or at least probably forever. The chance of Pioneers 10 or 11 entering another planetary system in, say, the next 10 billion years, is tiny, even if every star in the Milky Way <sup>9</sup> galaxy has planets. The reason is that the distances between the stars are very great, and space is very empty. It is a little like randomly throwing a dart in the dark in ~~a~~ Madison Square Garden to ~~the~~ <sup>whose</sup> walls ~~of which~~ are affixed 20 balloons. There is some chance of puncturing a balloon, but the likelihood of success is impressively small.

Nevertheless, Pioneers 10 and 11 are our first interstellar space vehicles, and they contain a message. Affixed to one of the antenna support struts of each spacecraft is a 6 x 9 inch gold-anodized aluminum plaque on which is etched a drawing which describes something of the epoch and locale of our civilization, portrayed in a scientific language which we hope is comprehensible to a scientifically literate civilization with no prior knowledge of our planet or its inhabitants. The plaque also contains a sketch of two representatives of the human species greeting the cosmos with hope. Three of the authors of this book were responsible for the design of the Pioneer 10 and 11 plaques and more details about it can be found in <sup>the next essay</sup> ~~Chapter~~ ~~below~~ as well as in Sagan et al. (1972) and Sagan (1973).

In 1974 a small satellite with a heart of solid <sup>brass</sup>~~uranium~~ was launched into a very high, very circular orbit around the Earth. It has external facets which make it look <sup>something</sup> like a giant golf ball. This satellite ~~was~~ <sup>is</sup> called LAGEOS, an acronym for Laser Geodynamic Satellite. One of its jobs is to measure continental drift on ~~the~~ Earth, which typically occurs at the very slow rate of an inch per century. To make such precision measurements LAGEOS must be placed in an extremely stable orbit, which is the reason for the heart of uranium and the high trajectory. Compared to other satellites it is impervious to the pressure of sunlight, the drag of the atmosphere and other factors <sup>that</sup>~~which~~ tend to cause a rapid decay of satellite orbits. <sup>PI</sup> The estimated lifetime of LAGEOS before it burns up in the Earth's atmosphere is eight million years. This is sufficiently far in our future that a great deal of information may be lost between now and then -- including information on the epoch and purpose of LAGEOS itself. For this reason the National Aeronautics and Space Administration asked me to design a small metal plaque to be affixed <sup>to</sup>~~on~~ LAGEOS as a kind of a greeting card to our remote descendants. ~~a time capsule to the distant future.~~ Briefly, ~~this on its equivalent~~ <sup>in effect</sup> the card says: A few hundred million years ago the continents were all as in the ~~top~~ <sup>top</sup> drawing. together. At the time LAGEOS was launched the map of the Earth looks as in the ~~middle~~ <sup>middle</sup> drawing. ~~like this,~~ Eight million years from now, when LAGEOS should return to Earth, we figure the continents will look <sup>as in the bottom drawing.</sup> ~~like this,~~ Yours truly. "A picture of the LAGEOS plaque appears on page \_\_\_\_\_ and more information on it in Appendix \_\_\_\_\_. <sup>PI</sup> The LAGEOS plaque is a time capsule containing extremely limited information ~~but~~ intended for the year 8,000,000. It is, like all such spacecraft messages, hitchhiking: the spacecraft is designed for one purpose and the plaque attached (almost always



at the ~~very~~ last minute) for another purpose. But it is pinpointed for a time in the future far more remote than any attempted before the advent of spaceflight.

and will, like the Sun and the <sup>nearby</sup> stars, orbit the massive center of the Milky Way galaxy, once every quarter billion years, essentially forever.

The first detailed and close-up study of Jupiter, Saturn, their <sup>or so</sup> ~~some odd~~ moons, and the exquisite rings of Saturn is to be made by the Voyager mission. These two spacecraft, formerly called Mariner Jupiter/Saturn, were launched in the summer of 1977, arrive in the Jupiter system in 1979 and in the Saturn system in <sup>1980/</sup> 1981. One of the Voyagers may, depending on what happens near Saturn in 1981, continue on to explore the system of the planet Uranus. ~~A more detailed discussion of the scientific goals of~~ ~~Voyager can be found in Chapter \_\_\_\_\_ below.~~ Like Pioneers 10 and 11, the Voyager spacecraft are so accelerated by their close pass <sup>age by</sup> ~~to~~ Jupiter, the most massive planet in the solar system, that they will be ejected ~~from out of~~ the solar system. <sup>Just as with</sup> ~~For just the same reasons as for Pioneers 10 and 11, it~~ seemed a pleasant and hopeful <sup>prospect</sup> ~~idea~~ to place some message for a possible extraterrestrial civilization aboard the Voyager spacecraft, ~~and~~ in December, 1976, while I was in Pasadena, California, for the mission operations of the Viking spacecraft on Mars, the Voyager Project Manager, John Casani, asked me to organize the effort to place an appropriate message aboard <sup>the two</sup> Voyager ~~spacecraft~~ vehicles.

My first thought was to make a modest extension <sup>S</sup> of the Pioneer 10 and 11 plaque, perhaps adding some information from molecular biology --

for example, on the structure of our proteins and nucleic acids. I organized a small group of scientific consultants to provide advice on the message content<sup>s</sup>, including Philip Morrison, Professor of Physics<sup>at</sup> Massachusetts Institute of Technology; Frank Drake, Professor of Astronomy and Director of the National Astronomy and Ionosphere Center<sup>at</sup> Cornell University; A.G.W. Cameron, Professor of Astronomy<sup>at</sup> Harvard University; Leslie Orgel<sup>of the</sup> Salk Institute for Biological Research; B.M. Oliver, Vice President for Research and Development<sup>of</sup> the Hewlett-Packard Corporation; and Steven Toulmin, Professor of Philosophy and Social Thought at the University of Chicago. Because some science-fiction writers with background<sup>s</sup> in the sciences have been thinking about such problems longer than most of the rest of us ~~had~~, I also queried my friends Isaac Asimov, Arthur Clarke and Robert Heinlein. A few other scientists were ~~also~~ asked to help but were by their schedules prevented it.

Many of these consultants <sup>emphasized</sup> stressed that receipt of the message by an extraterrestrial <sup>civilization</sup> was chancey at best, while receipt <sup>its</sup> of ~~the~~ ~~message~~ by the inhabitants of ~~the~~ Earth was guaranteed: the public would eventually have access to the message contents, as is in fact accomplished by this book. As Oliver put it, "There is only an infinitesimal chance that the plaque will ever be seen by a single extraterrestrial, but it will certainly be seen by billions of terrestrials. Its real function, therefore, is to appeal to and expand the human spirit, and to make contact with extraterrestrial intelligence a welcome expectation of mankind." Heinlein proposed that Voyager be equipped with a radar corner reflector so that it could easily be found by some future generation of fast terrestrial spacecraft, which could overtake and heave to this

ancient derelict. In a telephone message from <sup>Sri Lanka</sup>~~Ceylon~~ on January 3, 1977, Arthur Clarke recommended that the plaque contain a message to <sup>our</sup>~~a~~ remote descendant<sup>s</sup> saying, "Please leave me alone; let me go on to the stars," which he <sup>supported as,</sup>~~urged,~~ among other things, ~~as~~ a statement of hope that our civilization would continue long enough for that message to be read.

<sup>A</sup> Cameron proposed that the plaque be painted with a <sup>coating</sup>~~paint~~ of natural uranium whose decay products would give the recipients ~~of the plaque~~ a rough estimate of the length of time <sup>that</sup>~~which~~ had elapsed since <sup>it was</sup>~~launched~~. Toulmin <sup>warned against the</sup>~~cautioned that there is a~~ tendency in all such time-capsule messages to represent human beings as individuals without stressing the importance of community for the human species. He <sup>that we include</sup>~~urged~~ some representation of human beings in communities, cooperating together. Several of the scientists <sup>suggested</sup>~~stressed~~ <sup>since</sup> that the spacecraft itself contains ~~implicitly~~ so much information on our technology and physical sciences <sup>at least implicitly,</sup>~~that~~ the explicit message ought to be oriented in some other direction. Orgel thought there should be some schematic indication -- perhaps wavy lines -- that the Earth is a water-covered planet, and some indication of the molecular basis of terrestrial biology. <sup>A</sup> The laws of physics are, we already know, the same everywhere in the Galaxy, but the molecules <sup>that</sup>~~which~~ make up living beings <sup>may</sup>~~might~~ be very different elsewhere than on Earth. Some information on our nucleic acids and proteins might be considered very valuable by a recipient civilization. Several consultants urged that we send information other than scientific. Philip Morrison proposed sending the famous Leonardo da Vinci drawing of a man with arms outstretched<sup>✓</sup> and some comparable piece <sup>of</sup>~~from~~ Oriental art. Oliver proposed that behind <sup>a Voyager</sup>~~the~~ plaque, in a can, we send a magnetic tape, compatible with the tape recorder on the spacecraft,



containing the Beethoven Ninth Symphony<sup>1</sup>, or, ~~he suggested~~, if the lifetime ~~against randomization of the magnetic signature on~~ of such tape would be too short, a comparable wire recording.

*of the magnetic pattern on the tape*

In late January, 1977, the American Astronomical Society, ~~as well as~~ <sup>and</sup> its Division for Planetary Sciences were <sup>both</sup> meeting in Honolulu. As retiring Chairman of the DPS I was required to be at this meeting, and as a new member of the Council of the parent society, my Cornell colleague, Frank Drake, was there as well. At the Kawabata Cottage of the Kahala Hilton, Drake made ~~to me~~ the critical suggestion <sup>that</sup> ~~which~~ determined the subsequent course of the project, namely, that we send a long-playing phonograph record. Because sound information in such a record is physically etched in the record grooves, the information could last for very long times, comparable to or greater than the time for the spacecraft to venture to the stars. This avoided the problem ~~which Oliver had noted~~ <sup>the lifetime of</sup> about magnetic tape recordings. In addition, pictures could be encoded in the audio spectrum on such a record, so we could send in the same physical space aboard Voyager many more pictures than we could ~~had it been~~ <sup>on</sup> a plaque of the Pioneer 10 or LAGEOS sort. I later discovered that 1977 was the 100th anniversary of the invention of the phonograph record by Thomas Edison (although the original version was a wax [CHECK] disc) so a record would provide a fitting commemorative <sup>on</sup> ~~ive~~. (It also transpired, to our great regret, that the inventor of the long-playing record, Peter Goldmark, died in an automobile accident in 1977; the Voyager record can also be considered a memorial to his engineering genius.) *Thus, each Voyager spacecraft has a golden phonograph record in a silvery aluminum cover affixed to <sup>the outside of</sup> its ~~exterior~~ central instrument bay. Instructions for playing the record, written in scientific language, are etched on the cover, which is described further in Chapter \_\_\_\_\_. A cartridge and stylus, illustrated on the cover, are tucked into the spacecraft nearby. The record is ready to play.*

I was delighted with the suggestion of sending a record for a different reason: ~~the obvious implication that~~ we could send music. Our previous messages had contained information about what we perceive and how we think. But there is much more to human beings than perceiving and thinking. We are feeling creatures. <sup>However,</sup> ~~But~~ our emotional life is more difficult to communicate, ~~particularly~~ particularly to beings of very different biological make-up. ~~But~~ <sup>Music</sup>, it seemed to me, was at least a creditable attempt <sup>to</sup> ~~at~~ conveying human emotions. Perhaps a sufficiently advanced civilization <sup>would</sup> ~~will~~ have made an inventory of the music of species on many planets and, by comparing our music with such a library, might be able to deduce a great deal about us. I was impressed <sup>by</sup> ~~with~~ a paper by Sebastian von Hoerner of the National Radio Astronomy Observatory in Greenbank, West Virginia, which proposed that <sup>the physics of sound permitted</sup> ~~there are~~ only a very limited number of musical forms ~~which the physics of sound permitted~~. Perhaps there is a "universal" music. <sup>11</sup> In addition, I was delighted by a remark of the biologist Lewis Thomas, President of the Sloan Kettering Institute in New York City. When asked what message he would send to other civilizations in space Thomas replied with words to this effect: "I would send the complete works of Johann Sebastian Bach." <sup>12</sup> "But that," he added as an aside, "would be boasting."

With the help of Herbert Schlosser, President of the National Broadcasting Company, I made contact with Tom Shepard, Vice President, Red Seal Division, RCA Records, and established Red Seal's willingness to help us with the early stages of the technical end of the record design.

*Ames: Important to establish RCA here, for later developments.*

The pressing of an ordinary vinyl 12-inch long-playing record is made from a mold, which in turn is made from a copper or nickel positive master called a "mother." Since the technology for such an engraving was at hand, it seemed ideal to send ~~such~~ a mother to the stars. Its resistance to erosion in space would be considerably greater than ~~for~~ an ordinary vinyl record. Because nickel is ferromagnetic, ~~and~~ a nickel mother might interfere with the delicate magnetic field detection experiments of Voyager, <sup>so</sup> a copper mother was settled upon. By this time, in February and March, 1977, because we were thinking of a record to be played at the conventional 33-1/3 revolutions per minute, we contemplated something like 27 minutes of playing time on a side or 54 minutes altogether. One side would contain music and the other the non-musical information -- for example, pictures.

*Read following portion to Donor 2/14/78.* [ But <sup>what</sup> ~~which~~ music? Twenty-seven minutes is barely enough for two movements of a single symphony. How could we send something representative of the music of the planet Earth with its full range of emotion ~~and~~ tone and cultural diversity in 27 minutes? I asked for help from many sources. Jonathan Cott, an editor of Rolling Stone, and Ann Druyan, <sup>a writer,</sup> ~~of New York City~~ suggested I contact Robert E. Brown, the Executive Director of the Center for World Music in Berkeley and Alan Lomax, Director of the <sup>Cantometrics</sup> ~~Chorometric~~ Project of Columbia University in New York City. ~~After some initial delays,~~ ~~we were able to contact both with extremely important consequences.~~ Brown's recommendations are reprinted in <sup>Appendix</sup> ~~the box on page~~ \_\_\_\_\_, and



his ~~accompanying~~ comments represent the first coherent statement we received on possible organizing principles for the diversity of human music to be included. Another early set of recommendations -- this by Jon Lomberg of the Canadian Broadcasting Corporation -- appears <sup>in Appendix</sup> ~~on page~~. Murry Sidlin, ~~then~~ <sup>for</sup> the Resident Conductor of the National Symphony Orchestra in Washington and now the Musical Director of the New Haven Symphony, ~~made~~ <sup>made</sup> a number of proposals both for Western classical music and <sup>for</sup> music of other cultures, including the <sup>happy notion of following</sup> ~~proposal that we follow~~ the last seven minutes of Stravinsky's "Rite of Spring" with the "Prelude and Fugue Number One" from Book Two of Bach's Well Tempered Clavier. He noted that the emotional contrast would be striking. <sup>He</sup> Brown's recommendation was for 38 minutes of music and he clearly would have preferred more. Sidlin stressed the importance of including complete musical selections rather than fragments; and this, especially for Western classical music, would greatly increase the musical time required. Lomberg, independently of Lewis Thomas, felt that a number of pieces by the same composer or a number of pieces in the same form, such as the fugue, would illuminate our music and our intent.

No #

Alan Lomax ~~is Director of the Choreometrics Project at Columbia University~~ and has devoted his life to recording the ethnic music of the world and saving it from <sup>and neglect.</sup> obscurity. We finally <sup>made</sup> ~~were able to make~~ contact with him after his return from an extensive trip abroad. Most of the music on the

Voyager record <sup>that</sup> ~~which~~ is not in the Eastern or Western classical traditions was recommended to us by ~~Mr.~~ Lomax. He was a persistent and vigorous advocate for including ethnic music at the expense of Western classical music, and the pieces he brought to our attention were so compelling and beautiful that we acceded to his suggestions ~~to his suggestions~~ more often than I would have thought possible. There <sup>was</sup> ~~is~~, for example, <sup>room for</sup> no Debussy among our selections, because Azerbaijanis play flute music and Peruvians play pan pipes and <sup>such</sup> ~~these~~ exquisite pieces ~~of music~~ were recorded by ethnomusicologists

known to Lomax. <sup>Like</sup> ~~As with~~ Robert Brown, Alan Lomax had a proposed master list of music to include, which we only partially accommodated. After many decades of work ~~in ethnomusicology~~ Lomax believes that different stages in <sup>the</sup> development of civilization are characteristically reflected by certain styles of music -- ~~as~~ for example, hunter music, agricultural music, and so on. If his ideas are correct, it might have been possible to communicate something of the evolution of human civilizations through musical motifs alone. But time and other pressures prevented us from giving a full critical hearing <sup>to his</sup> ~~of Lomax's~~ proposals. Just as there are today many workers in wildlife conservation dedicated to noting and preserving endangered species, so Lomax has dedicated his life to preserving endangered folk and ethnic music. His <sup>Cantometrics</sup> ~~Choreometrics~~ Project is clearly operating on a shoestring budget and deserves much wider attention and support. We are particularly grateful to him for his help in broadening our transcultural musical perspectives, as well as in substantially enhancing the beauty of the Voyager record's musical offerings. ]

Anne: It is an obligatory acknowledgment, but in a good cause.

Not a non-sequitur.

By this time I had asked my friends, Timothy Ferris and Ann Druyan, to help with the record project. Both had strong musical backgrounds and were ~~very~~ enthusiastic about the idea of sending music to the stars. Ferris took charge of many of the production aspects of the project, particularly on the musical end, and Druyan provided essential contributions to the concepts of all of the non-pictorial aspects of the record contents. Fortunately, John Casani, <sup>of the Jet Propulsion Laboratory, NASA,</sup> had provided me with some money which permitted the project to hire these talented people for a limited period of time. With these funds I was also able to hire Jon Lomberg, ~~who is a prize-winning short story writer and a well-known artist on space subjects, especially galaxies, as well as a~~ <sup>a great deal of</sup> producer for the Canadian Broadcasting Company. These ~~people~~ <sup>individuals</sup> contributed ~~much~~ time for which they did not charge the project: and with a few minor exceptions, all others contributed their time and talent gratis. I detailed Lomberg to work closely with Frank Drake in the selection and design of the pictorial portion of the message. Druyan organized an audio essay, "The Sounds of Earth," an ~~while Druyan, Ferris, Brown, Sidlin and I -- and eventually Alan Lomax --~~ evolutionary sequence on the development of our planet, life, human beings, and ~~concentrated on the music.~~ the technical civilization responsible for the Voyager mission. She describes it in Chapter       .

Ferris and I considered a number of schemes <sup>for</sup> ~~of~~ increasing the amount of audio time available. Sending the equivalent of four sides, as two bonded pairs, of the record violated the time scale of the project: only the thermal implications of a single record mounted on



the exterior of the spacecraft had been allowed for. The temperature of the delicate electronics on board interplanetary spacecraft must be controlled with great precision if the scientific objectives of such missions are to be realized. Increasing the number of minutes per side much beyond 27 or 28 minutes by using a finer groove interval would result in a substantial loss in fidelity. Eventually we settled on having the record designed for 16-2/3 revolutions per minute, which would <sup>mean</sup> ~~imply~~ some loss of fidelity but <sup>not</sup> ~~one~~ which we believed would <sup>loss, especially if the recipients were as clever as they would have to be to acquire the record in the first place.</sup> ~~not be extremely severe.~~ Now With almost 90 minutes for music we felt we could at least approach doing some justice to the range, depth, and magic of the world's music. But this decision came uncomfortably late in the implacable development schedule of a major space mission. Not much time was left to make the selections.

To give some feeling of the nature of the decision making, let me describe a critical meeting held on May \_\_\_\_\_, 1977 in Washington, D.C. which lasted until 3 ~~a.m.~~ the following morning. I had been attending a meeting of the Council of the Smithsonian Institution and Druyan, Ferris, Linda Sagan and Wendy Gradison of my staff had spent

that time reviewing the non-musical sound collection of the Library of Congress. ~~Through the courtesy of the Smithsonian Institution and~~

~~Assistant Secretary for Public Affairs,~~ <sup>we</sup>  
met in <sup>an office at the Smithsonian,</sup> ~~his office,~~ which had a small hi-fi musical

system and a wall-sized portrait of Louis Armstrong to urge us on. The world's music is very rich and much of it is unfamiliar even to professional musicians ~~of some renown~~. There is obviously no best answer about what music to send to the stars: there are as many answers as there are people who attempt to make such a decision. In this case it was up to me to make the decision. Many issues were discussed. I had just asked Fred Eggens of the University of Chicago, a specialist in native American cultures, about some alternative choices in American Indian music. A major decision in the classical repertoire was whether to send several pieces by Beethoven and Bach at the expense of Hayden, say, or Wagner, or Debussy, a position

which Murry Sidlin vigorously opposed. But I was very sensitive to the feeling that Bach and Beethoven represent the best of the musical tradition of the West, the culture that launched the spacecraft. Once I had made this decision, Sidlin was extremely supportive and helped enormously in the individual selections. <sup>9</sup> One point of debate was whether to send the Miles Davis version of Gershwin's "Summertime." On the one hand it was argued that this was a <sup>pleasing transcultural</sup> mixture of African and American musical motifs; but the position <sup>that carried</sup> which held the day was that the black tradition in America has been a major, if not <sup>the</sup> a principal, source of important indigenous American music and should be presented without encumbrment. To seek ~~some~~ advice, Sidlin called Martin \_\_\_\_\_, the Curator of Jazz at the Smithsonian ~~Institution and the editor of~~ <sup>o</sup> ~~a marvellous record anthology of American Jazz available for purchase~~ <sup>a</sup> ~~through the Smithsonian Institution.~~ <sup>He</sup> Sidlin introduced himself and explained what we were about, <sup>when</sup> \_\_\_\_\_ interrupted and said, "Now, let <sup>'s</sup> me see if I get this straight. You're calling me up at home at 11:00 on a Sunday night to ask which jazz to send to the stars?" Sidlin confessed that that was the <sup>g</sup> gist of it and \_\_\_\_\_ -- like all the experts whose advice we sought -- was extremely helpful. <sup>9</sup> As it turned out, the four pieces of American music included were a Navajo night chant; <sup>o</sup> and three pieces from the American black musical tradition. One of them, Louis Armstrong's "Melancholy Blues," <sup>which Alan Lomax</sup> procured for us later ~~by Alan Lomax~~, will always remind me of Armstrong's visage gazing down at us from <sup>the</sup> \_\_\_\_\_ wall during our jam session of May \_\_\_\_\_, 1977.

*Smart A*



1/24/78

A, p. 22  
INSERT INTO CARL'S VOYAGER BOOK MANUSCRIPT:

Great care was taken with all the musical selections, in an attempt to be as fair and representative as possible in terms of geographical, ethnic and cultural distribution, style of music, and the connection with other selected pieces. After some deliberation we had tentatively selected for "Russian" music a basso, balalaika, and chorus selection called "The Young Pedler" performed by Nicolai Geda. It was rousing and more or less typical of Russian folk music, and had been suggested by Murry Sidlin. But we had lingering doubts. Geda was a Scandinavian, born of White Russian parents. Was he a true exponent of Russian folk music? How does the authenticity of a folk culture survive a major revolution like that of 1917 in Russia? Was the <sup>composition</sup> piece a little too ordinary? Might the <sup>entertaining</sup> theme of the piece -- a capitalist entrepreneur engaged in seducing young women -- be considered <sup>or at least atypical by</sup> offensive to contemporary citizens of the USSR? To ~~at least~~ approach these concerns I cabled a scientist colleague in Moscow, briefly outlining our requirements, and indicating that we had, at least for the time being, hit upon this particular version of "The Young Peddler" as exemplar of Russian folk music. Could he suggest one better? The short but not impossible deadline for response came and went without any answer from the USSR. Many weeks later -- too late to affect the outcome -- came the reply: an alternative piece called "Moscow Nights" was proposed. This turned out to be a kind of Soviet <sup>a</sup> Montovani, the blandest, least controversial and also least interesting music imaginable. I later discovered that my request had been given very serious attention, floating towards the top of the scientific hierarchy of the USSR Academy of Sciences, and possibly even higher than that. There were debates in which Lenin was quoted to the effect that even capitalist aspects of pre-revolutionary Russian culture were important and worth preserving.

But it is clear that this position did not carry the day. Fortunately, we had already selected something which I believe to be much better; Alan Lomax had called our attention to the splendid piece "Chakrulo" from Georgia in the USSR. The sentiments were about overthrowing a tyrannical landlord. In the ideal case we would have had extensive consultations with <sup>individual</sup> musical experts from many nations; while this was possible in some <sup>instances</sup> ~~cases~~ -- ~~such~~ as in our selection of Chinese music -- our time, budgetary and bureaucratic constraints were such that this was not our practice <sup>nearly so</sup> ~~as~~ much as I would have ~~liked~~ <sup>preferred</sup>. A detailed discussion of the musical selections is presented in Chapter \_\_\_\_.

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By late May 1977 the general configuration of the musical selections was becoming clear. Each selection to be included ~~on the spacecraft records~~ would have to have a copyright release, because the International Copyright Convention restricts the reproduction of a piece of music "for any purposes <sup>presumably including extraterrestrial purposes</sup> whatsoever," ~

In fact, for the flight models, royalties were actually paid of a few cents per selection. The securing of ~~such~~ copyright release is sometimes logistically arduous, and NASA, <sup>as</sup> ~~being~~ an agency of the United States government, wanted to be completely sure that it was ~~thoroughly~~ <sup>in every conceivable detail</sup> abiding by the copyright convention.

9 We had hoped that the RCA Victor's Red Seal Division would be able to secure these copyright releases for us, as well as to help in the actual production of the flight mothers. They had already been of very major assistance in the decision to go to 16-2/3 revolutions per minute and in ~~the decision on~~ the choice of mother material. But when Tom Shepard discovered that our tentative musical selections included at most one piece recorded by RCA Victor, he gently suggested that RCA might find it difficult to be of much further help. The musical <sup>repertoire</sup> ~~selections~~ <sup>selected</sup> ~~made~~ had been entirely without reference to the manufacturer of the recording ~~when available~~; but we discovered that a respectable number of our selections had been recorded by Columbia Records. It is not as easy as you might think to <sup>attract</sup> ~~gain~~ on short notice the attention of the president of a <sup>major</sup> competitive commercial record company for any enterprise, much less <sup>for</sup> volunteering corporate



resources to send a record to the stars, <sup>where</sup>, even if there are many potential listeners, no impact on corporate profits is likely to be made, <sup>at</sup> least in the near future. With the help of Arthur Taylor, formerly president of the Columbia Broadcasting System, I was, ~~to my great pleasure~~, able to <sup>Talk To</sup> secure the help of Bruce Lundvall, president of CBS Records; and CBS, entirely as a public service, secured <sup>all the releases</sup> ~~the copyright of all~~ musical selections on the Voyager <sup>Record</sup> and cut the wax masters from which the metal mothers are made. <sup>Worldwide</sup> ~~Copyright~~ releases were <sup>No responsibility of</sup> secured worldwide through the efforts of Joe Agresti, who noted that the releases were <sup>obtained them</sup> ~~secured~~ in an unprecedentedly brief time. Since there was no way that CBS Records could increase corporate earnings from this project, their cooperation, although in some quarters reluctant, was on the whole truly remarkable. The extremely challenging task of mixing the music, <sup>and</sup> ~~with~~ the sounds from many different sources obtained with very differing sound qualities, was done with great dispatch and skill of Russ Payne of CBS Records.

Meanwhile, interesting events were occurring on another front. The Pioneer 10 and 11 plaques had, in their most fundamental senses, been visual greeting cards. The Voyager records were <sup>as well as the optical</sup> ~~not in the optical but~~ in the audio domain, and it was natural to consider <sup>whether</sup> ~~that~~ they also should contain <sup>explicit</sup> greetings. It is barely possible that extraterrestrial civilizations might -- by the time the Voyager records were retrieved -- know something

Q: Will think about releasing this, but I'm afraid it's needed

of human languages, perhaps through the occasional interception  
of television broadcasts from the planet Earth. ~~But~~ <sup>to be sure,</sup> This is, at  
best an extremely long shot, <sup>and</sup> ~~by~~ <sup>will</sup> far the most likely situation  
is that no human language <sup>intelligible</sup> would be remotely apparent to an  
extraterrestrial auditor <sup>if no primer is included</sup> ~~has~~ <sup>previously been encountered</sup> But human spoken language might, never-  
theless, be of some interest; and if the record was to be a

greeting it clearly had to include a "Hello." But a "Hello" ~~just~~  
<sup>or in any other single language,</sup> in English, seemed particularly chauvinist <sup>is</sup> ~~is~~ The message in its  
fundamental sense was to be from all of mankind; therefore  
it should include greetings in the languages of at least <sup>a large proportion</sup> ~~much~~ of  
mankind. <sup>PH</sup> Perhaps naively I thought that the most appropriate  
organization to say "Hello" in a few dozen languages to the  
cosmos would be the United Nations. In the fall of 1976 I  
had been invited to give an address on space exploration to  
the U. N. General Assembly, and as a result I had met some  
members of the American Mission to the United Nations as well  
as ~~some~~ members of the U.N. "Outer Space Committee." But on  
so weighty a matter as saying "Hello," the United States Mission  
informed me that it could not act on its own. I then tried  
the Outer Space Committee but was told that the Committee  
cannot itself initiate any "action;" <sup>this</sup> ~~these~~ can ~~only~~ be <sup>accomplished only</sup> ~~initiated~~  
by national delegations. So back to the U. S. mission. ~~They~~ <sup>I +</sup>  
would act only if so instructed by the State Department. But  
the State Department, I soon learned, would act only if so

requested by NASA, <sup>with</sup> ~~including~~ a firm <sup>guarantee</sup> ~~statement~~ by NASA that there was definitely to be a Voyager record and that any U.N. greetings would be included. <sup>PH</sup> This posed a further dilemma. While my jerry-built committee of professionals and gifted amateurs was working under NASA auspices, NASA still reserved the right to veto our activities, <sup>or</sup> ~~or~~, in the ultimate remove, to decide not to include such a record at all. And indeed, when news of some of our activities ~~later~~ leaked to the press at ~~even~~ a later time, the official posture of NASA's Office of Public Information was that no final decision had been made about having a record on the Voyager spacecraft at all. This bureaucratic Catch-22 soon became still more convoluted. I was informed that I had blundered in making any request directly to the U.N. Outer Space Committee, because the Voyager record project was now viewed in some sectors of the United Nations organization as an enterprise possibly redounding to the credit of the United States, and <sup>therefore</sup> ~~to~~ be opposed on those grounds alone.

My suggestion had been that a day or two be reserved at United Nations Headquarters in New York City, ~~the U.N.~~ ~~sound studio utilized~~, and a delegate from each member nation <sup>the U.N. Sound Studio</sup> drop by sometime during that period to say "Hello" in his or



her native language. I had hoped that something like half of the voices could be male and half female, in order to reflect the distribution of sexes on the planet Earth. I was told that this was quite difficult on entirely other grounds. Virtually all the Chiefs of Delegation were male and it was unlikely that they would delegate the privilege of saying "Hello" to the stars to anyone else. Moreover, what if the Chief of Delegation was not at the United Nations on the designated day? No, my proposal was entirely impractical even if the U.S. Delegation were to propose it; indeed, even if the Secretary General were to suggest it. <sup>A</sup> As an alternative ~~proposal~~ <sup>suggested</sup> it was ~~put~~ to me that

each ~~adherent~~ member of the United Nations' Outer Space Committee might say "Hello" and we might send these voices to the cosmos.

The trouble with this, <sup>was</sup> of course, <sup>accidentally</sup> is that the languages which

~~are~~ represented by accident on this Committee do not closely correspond to the languages most commonly spoken on the Earth.

China, for example, does not belong to the Outer Space Committee.

What is more, the Outer Space Committee would have to vote on whether to say "Hello" or not, and its next meeting was to be in Europe in late June, 1977. I explained that even if greetings from the Outer Space Committee were <sup>desirable</sup> desirable, the launch schedule of Voyager would not permit such a dilatory pace. Could we not, I was then seriously queried, postpone the Voyager launch?

I ~~had~~ approached ~~Mr.~~ Arnold Frutkin, NASA's Associate Administrator for International Affairs, for help. Frutkin eventually succeeded in having the State Department instruct the U. S. Mission to the United Nations to help with this project, and also directly contracted the Secretary General of the United Nations, ~~Mr.~~ Kurt Waldheim. But again, ~~as~~ ~~with the music,~~ time was running out. Then late in the afternoon of May \_\_\_\_, 1977, NASA informed me that <sup>a U.N.</sup> ~~the~~ recording session would take place the following day. There had been no prior notice, and I was not <sup>told</sup> ~~informed~~ <sup>about</sup> anything ~~of~~ the format of the greetings <sup>that</sup> ~~which~~ would be given. I asked Timothy Ferris, who lived in New York, to attend the meeting and try to organize it along the lines we needed. In particular, I wanted to be sure that the greetings were very short; the amount of time available on the Voyager record for greetings was strictly limited. <sup>PH</sup> Ferris arrived to find a subset of members of the U. ~~N.~~ Outer Space Committee assembled, and not even <sup>a close</sup> ~~an~~ <sup>of</sup> approximation ~~to~~ the languages spoken on ~~the~~ Earth represented. Despite the fact that the Soviet Union is a member of the Outer Space Committee, there was no Russian-speaking delegate at the meeting. Ferris was permitted to give an introductory statement asking for "short greetings," but this phrase means something quite different at the United Nations than in usual spoken language. Each delegate clearly

wished to make a speech ~~to send to the stars~~. Some of the greetings were in fact quite lovely. The French delegate read poetry by Baudelaire and the Swedish delegate by the contemporary Swedish poet, Harry Martinsen. The Australian delegate made some of his remarks in Esperanto, perhaps on the grounds that Esperanto has been advertised as a "universal" language. The Nigerian delegate included the sentence, "As you probably know, my country is situated on the West Coast of Africa, a continent shaped like a question mark..." ~~(check)~~  
As interesting as these notices were, they were clearly too long to be included in their entirety, and we were forced to make a representative selection of them, <sup>being</sup> ~~making~~ sure to include at least some words from each speech by each member of the Outer Space Committee. *A Transcript of the original messages appears in the Appendix*

Roger Payne of Rockefeller University is a zoologist who has performed important studies of great whales in <sup>the</sup> free ocean. He has trailed hydrophones From a small boat beneath the surface of the ocean and recorded the tantalizing, enigmatic, haunting "songs" of the humpback and other whales, some of which last for a half an hour or more and are later repeated essentially identically. Payne believes that these songs are true communications among the whales when they are so far apart that they cannot see or smell each other, and that one particular kind of song



is used as a greeting among the humpback whales. So<sup>as</sup> to leave no hint of provincialism in the greetings from the United Nations' delegation<sup>s</sup>, we mixed these characteristically human greetings with the characteristic "Hello<sup>s</sup>" of the humpback whale -- another intelligent species from the planet Earth ~~paying~~<sup>sending</sup> greetings to the stars.

~~Also~~<sup>had</sup> unknown to us, the United Nations<sup>had</sup> announced the recording session to the press and identified Timothy Ferris as a NASA official. As a result, our wish to keep the enterprise from the attention of the news media until we actually completed it was thwarted. In addition, there were a number of NASA officials who felt miffed at Ferris' misidentification. Our committee could not represent NASA, it was sternly explained to me.

The next day I made still another discovery; ~~namely that~~  
~~the Secretary General of the United Nations, Kurt Waldheim,~~  
had made a speech of cosmic greeting for the Voyager record. While we had never requested it, ~~this~~<sup>the</sup> speech was so sensitively and gracefully composed, and so appropriate in its sentiments) ~~to the objective of the Voyager record project,~~ that I felt ~~that it must be included.~~ ~~Mr.~~ Waldheim's remarks ~~are~~ <sup>appear</sup>

~~on page~~ ~~reproduced in the accompanying box.~~ But now a further question came to mind. Would it be appropriate to have some remarks by the U. <sup>N.</sup> Secretary General on board the Voyager spacecraft -- an American <sup>s</sup> space vehicle -- if there were no comparable remarks from the President of the United States? It seemed to me that the President should <sup>at the very least</sup> be given an opportunity to greet the cosmos. <sup>I</sup> I called the President's Science Advisor, Dr. Frank Press, who promised he would put the question to the President and give me <sup>a rapid response</sup> ~~an answer rapidly~~.

The reply came back in a few days that the President would like to consider such a message, ~~and would I provide a suggested~~ <sup>an appropriate</sup> greeting? I prepared some remarks <sup>that</sup> which I thought might be <sup>suitable</sup> appropriate and was delighted that they were <sup>by and large</sup> adopted essentially in their original form. My career as a Presidential speech writer is probably a very short one but I am not sure that there are many political leaders who would have signed a message associating themselves with so broad an astronomical perspective.

⌞ The President elected to have his message sent to the stars in written form, like one of the 116 pictures, rather than in spoken form <sup>like</sup> ~~as~~ Secretary General Waldheim's remarks. ~~After the President's~~ <sup>(It is reproduced on page 00.)</sup> After the President's statement was released by the White House, commentary in newspapers and the electronic media seemed to me to be almost entirely positive, with the exception of one newspaper which felt it had discovered that the President was a "closet one-worlder."

Anne: Lot's discuss  
1 version vs. 2.

For those who might find a comparison of the original draft with the one which the President actually signed interesting the two are printed side-by-side <sup>on page —</sup> in the accompanying boxes.

The causal chain <sup>2</sup> ~~now~~ continued. NASA officials were concerned that the separation of powers in the U. S. Constitution might imply that if the President could greet the stars so must the representatives of the Legislative Branch of the government. After weighing the matter for about a day, NASA decided that it was essential to include on the Voyager record at least the names of a large number of senators and representatives, especially those whose committees had cognizance of NASA activities. As a result, four additional pictures were added at the very last moment to the Voyager record with the information that is contained in the <sup>on page —</sup> ~~accompanying~~ boxes. So in case the reader wonders how it is, say, that Senator John Stennis of Mississippi has his name aboard the Voyager record, I suppose it goes back to Kurt Waldheim and the nature of bureaucracies, ~~everywhere~~. I was at least pleased that NASA did not insist on including the names of the members of the U. S. Supreme Court, as the logical conclusion of the separation of powers <sup>on</sup> argument. This part of the Voyager message is without a doubt a signal to down here rather than to up there.



The late arrival of the <sup>P</sup>residential and particularly the <sup>C</sup>ongressional material caused a range of organizational problems. The 116 pictures had already been transcribed into the appropriate format for the record at Colorado Video in Boulder, Colorado. A special Honeywell 5600-C Recorder had been lent to us for this purpose by the manufacturer. The entire technical end of the picture transcription had been supervised as a public service by personnel of the National Astronomy and Ionosphere Center at Cornell ~~University~~. The addition of the new material ~~now~~ required re-borrowing the Honeywell Recorder, flying it <sup>again</sup> out to Boulder, ~~Colorado~~, and imposing once <sup>more</sup> ~~again~~ on the good will of Colorado Video, <sup>all</sup> on an exceptionally tight time scale. <sup>41</sup> Valentin Boriakoff of NAIC met me at NASA Headquarters in Washington where I gave him the Presidential message and NASA's list of members of Congress to be reproduced as 35mm slides in a commercial photography laboratory in suburban Washington. Because the White House understandably wished to itself release the contents of the President's message, Boriakoff was to be present at every stage in the photographic process to make sure that no unauthorized copies were made. This <sup>done</sup> ~~accomplished~~, he flew on to Denver. Meanwhile, Dan Mittler of NAIC flew from Ithaca, New York to Newark, New Jersey, and collected the Honeywell Recorder preparatory to flying with it to Denver. The Recorder was so rare and the time scale so short that we could not take the risk of having it sent in the baggage section of the flight. We, therefore, wanted to reserve a seat for <sup>it</sup> ~~the Recorder~~. It turns out that airlines have difficulty coping with the concept of ~~reserving~~ a seat for a piece of equipment. <sup>The solution, we found,</sup> ~~The only way to accomplish this~~ was to reserve a seat for an individual named Mr. Equipment. Since Mr. Equipment was under the age of 10, he was able to fly at half fare. Ad astra per burocracia.

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~~Since~~ The Outer Space Committee greetings proved such  
a poor representation of the languages spoken <sup>on</sup> ~~of~~ the planet  
Earth, <sup>that</sup> emergency measures had to be instituted. Frutkin <sup>thoughtfully</sup>  
proposed giving a cocktail party in Washington for members  
of various ambassadorial delegations, ~~which was an extremely~~  
~~thoughtful suggestion;~~ but I was leery of another <sup>diplomatic</sup> round  
with <sup>the ponderous</sup> bureaucratic machinery. Instead, I recalled that Cornell  
University, where I teach, has a very wide range of foreign  
language departments and, with the aid of Harry Levin, Dean  
of the College of Arts and Sciences at Cornell, <sup>Linda Sagan,</sup> and many others,  
a ~~very~~ representative set of short greetings from the human  
community was assembled, <sup>beginning with Sumerian, one of the oldest known</sup>  
<sup>languages and ending with this greeting from an American 5 year old:</sup>  
~~55 languages, and a transcription of some of the remarks by~~  
"Hello from the children of planet Earth." They are described further  
delegates of the U. N. Outer Space Committee which were  
in ~~Chapter~~ <sup>"A Voyager's Greeting."</sup>  
included in the Voyager Record can be found in Chapter \_\_\_\_\_.

In early June, immediately after the mixing of the greetings, music, and "Sounds of Earth" portions of the Voyager record, a delegation of NASA officials <sup>arrived at</sup> ~~came to~~ the CBS Records recording studio ~~at~~ in New York City to be sure that no untoward sound or musical selection, no ditty <sup>that</sup> ~~which~~ might embarrass NASA, had been included. Their responses ranged from recognition (of "Johnny B. Goode") to bland approval, and it was clear that no great passions or dangerous noises had been stirred up. But the next day I received an agitated phone call from a NASA Associate Administrator concerned that no Irish music had been included in the record. The Speaker of the House, it had suddenly been recalled, was of Irish descent and NASA was concerned not to give unwonted offense. I had to explain <sup>Unfortunately</sup> that there were many ethnic groups ~~that were~~ unrepresented. <sup>There was, for example,</sup> ~~no example~~ of Italian opera, <sup>for example,</sup> ~~or of~~ Jewish folk music. No, it was too late to include "<sup>Danny</sup> Minstrel Boy" ~~Minstrel Boy~~.

There is, ~~of course,~~ not the slightest evidence that any member of Congress or ~~member~~ of the Executive Office of the President attempted in any way to influence our choice of music, ~~and such self-protective concerns by NASA, I believe, do a disservice to those members of the government for whom these intercessions were ostensibly performed.~~ The only <sup>such</sup> attempt, ~~to influence our choice of selections made other than by NASA,~~ was made by an official of the United Nations who urged us to include a ~~melodic~~ piece



by a composer from his homeland. We found ourselves unable to comply <sup>with this request.</sup>

There were a number of principles behind our selection of pictures for the Voyager record, but the chief one was this: Send to any possible extraterrestrial auditors information about the Earth and its inhabitants <sup>that</sup> ~~which~~ they are unlikely <sup>(to otherwise)</sup> find themselves in possession of. Extensive information on mathematics or physics or astronomy, therefore, <sup>was</sup> ~~were~~ excluded. Some scientific and mathematical information was included to begin the picture sequence in a comprehensible way and to provide background for information on subsequent pictures. But the principal focus of the pictorial information was information <sup>that</sup> ~~which~~ might in some sense be unique to ~~the~~ <sup>g</sup> Earth: information on geochemistry, geophysics, molecular biology, human anatomy and physiology, and our civilization. The more specific the information is to ~~the~~ Earth, the more anecdotal or idiosyncratic, the more difficult it <sup>may, for extraterrestrials</sup> ~~might~~ be to understand. <sup>But</sup> here, as with much else on the Voyager record, we recalled that the likely recipients <sup>would be</sup> ~~were~~ much more advanced than we. Since neither Voyager spacecraft would even in ten billion years enter under its own power another planetary system -- even if every star in the Milky Way Galaxy had <sup>5</sup> planets -- the record could be received only by a civilization able <sup>(to easily)</sup> traverse the spaces between stars. Such a civilization must have intellectual and technological gifts far beyond our ken, as well as, perhaps, an acquired <sup>will be,</sup> ~~but also the more valuable the information, once understood.~~

inventory of characteristics of diverse planetary biologies and cultures.  
 If <sup>such beings</sup> ~~they~~ had not yet heard much about ~~the~~ Earth, the record might prove  
 not only (useful but also) readily understandable. And if they had by  
 this remote time in the future learned much about ~~the~~ Earth, the record  
 would at least provide some psychological insights on what a few of us  
 thought important <sup>to tell about ourselves.</sup> The Voyager pictures are  
 described and reproduced in Chapter —.

Among the ~~sequence of~~ <sup>Tuas</sup> pictures which we ~~therefore~~ felt important  
 to include was one on human reproduction. There is much in it that is  
 biologically informative -- including the astonishing fact that there  
 is a one-celled stage in the human life cycle, the stage of sperm and  
 ovum. It did not seem likely to us that any depiction of human reproduc-  
 tion, no matter how graphic, might be perceived as pornographic by the  
 recipients -- any more than we might find a scanning electron micrograph  
 of the conjugation of two bacteria uncomfortably stimulating. But NASA  
 had made clear to us that sexual information of a particularly explicit  
 character might have unpleasant repercussions back here on Earth. The  
 Pioneer 10 and 11 plaques <sup>on the</sup> ~~contained~~ a depiction of a naked man and woman  
 greeting the cosmos <sup>which</sup> ~~which~~ was criticized both on the grounds of being  
 insufficiently explicit and on the grounds of "sending smut to the stars."  
 (A further discussion <sup>of</sup> ~~on~~ reaction to this aspect of the Pioneer plaques  
 is contained in my <sup>first</sup> ~~book~~ The Cosmic Connection.) But the complaints <sup>on</sup>  
 this aspect of the Pioneer 10 and 11 plaques were, on the whole, muted  
 and few, and it hardly seemed possible to describe human reproduction

Can we either leave some duplication with Don's  
 material, or move the unduplicated portions  
 to his chapter?

while ignoring the existence of genitalia. Accordingly, we selected a photograph ~~which~~ we considered to be extremely tasteful of a young man and woman in whom might be discerned a fond regard for one another with the woman clearly several months pregnant. They were facing the camera, as required by the logic of the picture sequence, but the amount of prurient interest seemed to us minimal. The picture also satisfied the criteria that it had not appeared in any publication <sup>that</sup> ~~which~~ might reasonably be considered pornographic and that it had not been taken for the purpose of the Voyager message. The picture is reproduced in this book on page \_\_\_\_\_ -- but <sup>it</sup> will not be viewed by any extraterrestrial interpreter of the Voyager message.

After our final selection of the (originally) 117 photographs I took a 35mm slide of each to Washington to <sup>show to</sup> ~~preview for~~ NASA officials. <sup>Again</sup> ~~One~~ NASA was concerned about ~~concern was, as for the musical selections,~~ copyright release. On this we satisfied <sup>their</sup> ~~NASA~~ requirements admirably. But there were questions raised <sup>about</sup> ~~on~~ content. The time was now so late that no new materials could be added. It was either a question of yes or no with each of the 117 pictures. Why no great works of art? Good question; because we did not have time to put together a committee of art historians and critics to make a reasonably professional choice. Why not include the houses of worship and artifacts of the three or four major religions? Because there are at least a dozen and probably hundreds of major religions on the Earth and adherents of the omitted religions would very likely produce an outcry much more serious

For 9 years  
would like to say  
this is the end  
it only is.



than any feared because of non-representation of some tradition of ethnic music. Many of the questions were good ones, and all of the answers were accepted. Except one. There was no way that NASA was going to launch full frontal nudity to the stars.

OK  
The Voyager record was an enterprise very different from any that NASA had previously attempted. NASA is essentially an engineering organization, with occasional forays into science and with at least some practical political sophistication. Its mere survival provides some indication of the latter. Some of its public relations people never resonated with our vision of the Voyager record as a memento of the human spirit to other times and beings, as a harbinger of a future human presence among the stars. It might, some of them feared, annoy members of Congress or the public or others upon whom NASA financial support is tenuously dependent. The press attention given to the record might make members of the public think that the record rather than the scientific investigation of the outer solar system was the point of the Voyager missions. Despite these potential hazards, the records were prepared, affixed to Voyager, and launched to the stars. This is due mainly to the enthusiastic support within NASA of a few officials, including John Casani the Viking Project Manager, A. Thomas Young, Director of Lunar and Planetary Programs, Noel Hinners, Associate Administrator for Space Sciences, and Alan Lovelace, then Acting Administrator of NASA. Considering the nature of bureaucracies, I suppose it is a wonder that the project was completed and nearly intact. But I

am still disappointed that that couple never went to the stars. Any extraterrestrial recipients will have to content themselves with the outline sketch shown on page \_\_\_\_\_. It is not much but perhaps it is enough to fill in some of the blanks on human physiology. But, if interpreted properly, it will speak volumes about bureaucracy and human sexual repression.

[Anne: I may have been excessively harsh in the last few paragraphs and may want to soften some passages a little later.]

We had wanted to keep information about the Voyager record out of the press until all was completed -- in part to ~~undo~~ <sup>thwart</sup> any temptations to tamper with the repertoire, but also because if information on the various parts of the record came out in bits and pieces an incomplete impression of our intentions would gain currency. But ~~there~~ <sup>there were</sup> too many people involved in too many phases of our work, and leaks ~~were inevitable~~ <sup>occurred</sup>. The United Nations release gave the impression that spoken greetings and non-musical sounds were the main focus and prompted Charles Osgood of CBS News to offer these verses to his listening audience on May 12, 1977:

"I don't see it mentioned, but please, NASA, please,  
Include on your intergalactic L.P.'s  
The sound of our music. Please give them a song.

Permanently  
repeated

To not put in music would surely be wrong.

Without Bach or Mozart, the picture's not whole.

You'd give them our minds; would you leave out our soul?"

It was a pleasure to have already anticipated Mr. Osgood's plea. However, in late July, ~~1977~~<sup>9</sup>, just a few weeks before the Voyager launch and less than two weeks before the official NASA press release on the record, I was called by Jonathan Spivak of the Wall Street Journal ~~about the record contents~~. In the best investigative reportorial tradition ~~he~~<sup>he</sup> Spivak had ~~(from various sources)~~<sup>(from various sources)</sup> clearly ferreted out ~~much~~<sup>many</sup> of the record ~~selections~~<sup>and wanted to know the rest</sup>. I was as cooperative as I could be within the constraints of not giving him any new information, and on July 26, ~~1977~~, the first public announcement of the music on the Voyager record appeared in the ~~Wall Street Journal~~<sup>Journal</sup>. The headline was, "Are Jovians Ready for Sweetest Music That Side of Heaven?" But unfortunately, the first paragraph revealed that somehow Spivak had been led to believe that some Duke Ellington ~~music~~<sup>music</sup> was to be included. The Spivak release ~~then~~ forced NASA to issue its own press release far ahead of schedule, resulting in a far less comprehensive ~~announcement~~<sup>and list of acknowledgments</sup> than we had anticipated. ~~A very large number of individuals gave of their time, expertise, photographs and recorded sounds and music with no thought of personal gain. They all should have been acknowledged. What I hope is a complete list of acknowledgments appears in the present book. (Page \_\_\_\_\_.) The NASA Office of Public Information~~



belatedly held a press conference on the record the day after the launch. But it was held in a room of Wolfie's Motel in Cocoa Beach; the NASA sound system failed; and the meeting room was thinly partitioned from an adjacent ethnic wedding celebration. Unfortunately, the music which overwhelmed our press conference from the adjacent festivities fell short of the standards of much of the Voyager ethnic music.

Stat  
Despite these and other impediments, the Voyager record project has attracted attached and continues to attract substantial interest, most of it favorable.

An article in Science News by Jonathan Eberhart began:

Describe the world. Not just that multi-colored ball in the spacecraft photos, but the world -- its place in space, its diverse biota, its wide-ranging cultures with their lifestyles, arts and technologies -- everything, or at least enough to get the idea across. And do it on one long-playing record.

Oh, there's one stipulation: Assume not only that your audience doesn't speak your language, but that it has never even heard of the Earth or the rest of the solar system. An audience that lives, say, on a planet orbiting another star, light years away from anything

OK, I agree. Could be longer, revised this, esp. pp. 45, 46, + see if anything should be revised?

you would recognize as home.

After a detailed and admirably accurate account of the record contents Eberhart concluded:

STET.

u STET "Try it. Make your own list. Or imagine: If you, as an alien, got this message, what would you think?"

Five weeks later Science News editorialized "There may well be as many versions of what such a message contained as there are earthlings, and even the response we've gotten would fill our limited Letters column for weeks." Many of those whose works were included wrote us to tell us of their delight. For example, the picture section included a photograph of distinguished primatologist, Jane Goodall, studying chimpanzees in East Africa. The photograph was taken by her mother, Vanue Goodall [CHECK] who wrote "I am still completely overawed by the knowledge that I once pressed the button for a photograph which is now on its way to outer space, and still more so because my daughter, Jane, has merited the unique honor of representing an area of study on the planet Earth." Mrs. Robin G. Lee of Ocean, New Jersey, wrote, "Right now, today, the Earth is the only home we have. Everything on Earth is one, it is all

Include  
in  
Jon's  
caption  
please.

part of the very stuff the stars and the rest of the universe are made of. We are all part of the universe, and it is part of us. I sincerely hope that someday, many hundreds of thousands of years from now, this message does reach some far away world. But will it really be that far away? They will be our relatives, for their world, too, will be part of the same universe that our world is a part of." The record seemed to elicit many other thoughtful, philosophical or evocative sentiments. Robert Martin, President of Black Americans for Outer Space, wrote, "All [our] members . . . thank you for selecting Louis Armstrong and . . . "Blind" Willie Johnson . . . to be put aboard Voyager . . . These two men are in our estimate ranked with those black fighter pilots of World War I, the missing Glory Angels, that paved the way for America's walk amongst the stars via Apollo 11." Substantial parochial interest was elicited, particularly among those who deal with communications among human beings. Derrick Jelliffe, head of the Division of Population, Family and International Health at UCLA's School of Public Health, wrote to ask if they could include the photograph on page \_\_\_\_\_ on the cover of a newly completed book entitled Human Milk in the Modern World. Very large numbers of people wrote to ask if a commercially available version of the record might be in the offing. We are still hopeful that such a two-record album <sup>may be made, even though</sup> ~~might be available, but~~ CBS Records, <sup>is understandably</sup> ~~is~~ unsure of how to estimate the sales of such an album <sup>STET</sup> ~~has~~ ~~still, as of this writing, (January, 1978) been unable to commit itself to such a production. Some letter writers expressed various concerns.~~



unsuspecting sailors with their boats into the billowgrave of the Mediterranean." It would be nice if the extraterrestrials were already here and surely save us a great deal of trouble -- not only in enterprises like the Voyager record but in much more serious and difficult searches for extraterrestrial intelligence through the use of large radio telescopes. Unfortunately, there is not a smidgen of evidence that we are being so visited. But if we are I suspect that our visitors will treat kindly our halting efforts to greet the cosmos.

Some were concerned that aspects of the record might be unintelligible even to very sophisticated extraterrestrials. The editorial comment in the British journal New Scientist commented: "I hope the little green men won't assume on the strength of the First Movement of the Second Brandenburg, that it's gods they're dealing with. Unless, of course, they've been here already, in which case their laughter when they open the package will be heard all the way from Uranus . . ." Some people imagined the confusion that the decoded record might elicit in extraterrestrials of very different form from humans. Louise Ireland-Frey of Cedaredge, Colorado, wrote a tongue-in-cheek extraterrestrial memorandum called "Report on Artifact Found Free-flying in Space."

[ANNE: Three paragraphs from page 221 of Oct 1, 1977 Science News to come. I will send them along indicating they should be inserted here.  
-- shirley.]


*mailed attached S.*

*6*

"On the other side of the metal disc we managed to decipher picture-images of articles and creatures we take to be those common on the alien orb. A few are recognizable (as images of planets, diagrams of systems, etc., especially). Many are of strange figures, apparently all drawn as if viewed horizontally on a level with the object, not (as with practiced space explorers) from a higher level looking down, with shadow-studies providing horizontal configurations. This is very interesting, revealing that this species must have begun space exploration only a short time before sending out this artifact....

Our experts have studied the pictures carefully and with puzzlement. It is sad that these pictographs of the various aniplants do not show how much is carapace and how much is pile and soft matter, nor how much is pile and soft matter, nor how much is reducible, how much elatable, etc. The earlier-discovered artifact, showing what we thought to be pictographs of constellations -- inasmuch as the diagram of a sun-planet system was clearly discernable below -- now appear to have been vastly enlarged (relative to the planetary diagram) pictographs of two of the aniplants shown on the rubrous metal disc!

We are of the opinion, after conferring together, that these are two rather similar species, both quite common on the orb, perhaps even like the creatures who made the disc and some of the other articles. Both have smooth carapaces and unfurred facial areas; both have pile on that aspect of the head-end that is apparently the end farthest from the planetary surface (if, as we assume, the figures are intended to be viewed as if from the horizontal). The pile must be equivalent of



our fur-basins, but located on the upper aspect of the head-end, for  
the holding of the eggs or spores .... They show no signs of budding ...."



¶ Most of the comments on the Voyager record project — in the press and in hundreds of letters — were positive and supportive, and encouraged us to think that we-46- had succeeded in communicating something of our vision of the project's purpose.

As with Pioneer 10 and 11, a few individuals were worried that the record would "give away" our position in the Galaxy, as a preliminary to some dire interstellar invasion. But at least for the next million years or so the trajectory of the spacecraft itself will quite clearly indicate that it is from the Sun, to say nothing of the sobering fact that our military radar and commercial television indicate the Earth to be an abode of some form of possibly intelligent life -- and these signals travel at the speed of light.

¶ Colman S. von Keviczky, <sup>the</sup> Director of something he calls "The International UFO Galactic Spacecraft-Research and Analytic Network," <sup>9</sup> He is convinced that we already have clear evidence of extraterrestrial visitation and is concerned that our visitors may be confused by our sending greetings into interstellar space. In a letter to the U.N. Secretary General, <sup>a copy of</sup> which von Keviczky was kind enough to send to me, he writes, "The world's military powers have been classified [sic] the UFOs strategic survey as espionage, endangering the national security! In light of these accurate military attitude, the NASA's attempt to seek communication with 'possible' extra-terrestrial intelligence is not only brazen inconsistency but seems to be sheer hypocrisy." ~~His concern that Mr. Waldheim's message, "We step out of our solar system into the universe seeking only peace and friendship . . ."~~ might "easily be interpreted by the extra-terrestrial intelligence forces ~~as the lure songs of the mythological calypso nymph, who . . . decoyed~~

*Ann: This I think is worth  
saying several times*

A few writers <sup>also</sup> criticized us for presenting ~~generally~~ only the favorable circumstances of mankind and chided us for not including <sup>devastation</sup> scenes of famine, ravaged cities, and nuclear weapons explosions. This is an issue ~~which~~ we debated long and hard during our deliberations on repertoire. There is no question that <sup>destruction</sup> ~~this is, unfortunately,~~ a characteristic aspect of what we are pleased to call human civilization. But ~~for one thing~~ such a message content might be misinterpreted. Might a photo of a thermonuclear explosion be considered by an extraterrestrial civilization as a pathetically feeble but still <sup>palpably</sup> nasty attempt at threat? Bernard Oliver had the nice idea of showing a human being with arms outstretched to a galaxy, symbolizing our wish to embrace our fellow creatures among the stars. But a comparable ambiguity seemed to me possible here as well; <sup>could be interpreted by</sup> ~~and the gesture interpretable to~~ an uncharitable recipient as an <sup>earnest expression</sup> ~~intent~~ of galactic aggrandizement. <sup>Besides,</sup> ~~but~~ is it a mistake to put our best face to the cosmos? We <sup>tried to send</sup> ~~have sent some attempt at~~ our best music, ~~not our worst~~. Why not a hopeful rather than a despairing view of humanity and its possible future? ~~Charles Osgood's verses on the Voyager record imagine the recipients constructing their amplifiers and playing the record:~~

"Perhaps when he does he will wonder and fear:  
'Lord of the universe, what have we here?  
What kind of spirit has put down so much  
and reached out across the vast spaces to touch?'  
Or perhaps he will find it and on the same day  
Will see it, not hear it -- and toss it away."



By <sup>the</sup> middle <sup>of</sup> June, ~~1977~~ <sup>the</sup> deadline given to us by John Casani had <sup>had</sup> expired as well as about ten days ~~which~~ he had hidden in his hip pocket, knowing ~~that~~ there would be last-minute emergencies. The music had been mixed and a master magnetic tape prepared, which contained all the non-pictorial contents of the record. This was ~~then~~ combined <sup>at CBS</sup> with the pictorial information on two wax masters, which Timothy Ferris then hand-carried to Los Angeles where the copper mothers were prepared. So there would be something ~~on the record~~ done directly by the human hand, Ferris had an inscription <sup>etched directly on the record,</sup> ~~emplaced,~~ circumscribing the interior ungrooved portion ~~of the record~~ where the record label would ordinarily be. <sup>It reads,</sup> ~~The inscription etched by [name, company]~~ says "To the makers of music, all worlds, all times." <sup>And</sup> in place of the label we have photo-engraved a photograph of ~~the~~ Earth taken from space, to which is added the words "United States of America, <sup>Planet</sup> Earth." [CHECK.] <sup>on each space vehicle</sup> The bonded pairs of records are not heavy, but they have a substantial heft. They glisten, golden, in the sunlight. Encased in ~~their~~ aluminum cocoons, they were affixed to the flight spacecraft with, in each case, the stylus and cartridge nearby. The rendezvous of record and spacecraft occurred at the John F. Kennedy Spaceflight Center at Cape Canaveral, Florida and is shown in the photograph on page \_\_\_\_\_.

### Titan III-E Centaur

Once the spacecraft <sup>were</sup> ~~are~~ mounted on the top of their ~~giant~~ launch boosters they <sup>were</sup> ~~are~~ put through a series of electronic tests to be sure



that all <sup>was</sup> ~~is~~ still in working order. <sup>they</sup> ~~The spacecraft~~ passed all tests, ~~and~~  
<sup>August 20,</sup>  
~~and~~ the day came, ~~[Date]~~ when the first Voyager was ready to be launched to  
the planets and the stars. First to leave ~~the~~ Earth was Voyager <sup>2</sup> ~~II~~.  
Because of the intricacies of the interplanetary trajectories Voyager <sup>1</sup> ~~I~~,  
although launched later, would arrive at Jupiter earlier. All the authors  
of this book and many others connected with the Voyager record were at  
Cape Canaveral on that day for the launch. It had been an arduous and  
sometimes thankless task, but a supremely satisfying one as well. We had  
pushed at immobile bureaucracies, <sup>and</sup> ~~let~~ our many other responsibilities  
slide <sup>and</sup> ~~and experienced a set of major changes in our personal relationships.~~

Perhaps the Voyagers would never be recovered by some extraterrestrial <sup>society</sup>.  
<sup>making the record had provided us with a unique</sup>  
~~civilization.~~ But ~~it was an~~ opportunity to view our planet, our species, ~~and~~  
our civilization as a whole, <sup>to</sup> and imagine the moment of contact with someone-  
<sup>other planet, species and civilization</sup> ~~else.~~ The Voyager <sup>2</sup> ~~II~~ launch <sup>was</sup> ~~occurred~~ flawlessly, and it was with a sense  
of exhilaration mixed with many other emotions that we saw it gracefully  
penetrate the cloud cover and vanish into the blue sky and the black of  
space beyond. We <sup>and embraced,</sup> ~~hugged and~~ kissed, and many of us cried.

## Epilogue

It was impossible to view the last tongues of flame <sup>from</sup> of Voyager's <sup>Titan booster</sup> as it  
<sup>from Cape Canaveral</sup> ~~departed~~ <sup>the</sup> ~~without contemplating its fate.~~ <sup>of the record.</sup> The record is affixed to the  
exterior of the spacecraft. While cosmic rays and radiation from the

it  
Sun and stars could cause some damage, the main threat to ~~the record~~ <sup>are</sup> is  
micrometeorites, tiny microscopic particles of fluff, probably the  
debris of comets, which fill interplanetary space. These microplanets  
are in orbit <sup>about</sup> ~~around~~ the sun and have their own velocities, but as the  
spacecraft ventures <sup>a</sup> ~~farther~~ into the outer reaches of the solar system,  
those velocities ~~will~~ become less and less. The spacecraft's own  
velocity of about 15 kilometers a second as it plows through this  
horde of micrometeorites poses the <sup>chief</sup> ~~main~~ hazard. The most conservative  
estimate of damage <sup>is based</sup> ~~occurs~~ on the assumption that the spacecraft will be  
traveling record first. If the record were not encased in its aluminum  
cover, all particles <sup>that</sup> ~~which~~ could produce tiny pits or craters larger than  
about half a record groove could cause damage to the sound quality. In  
this case, all micrometeorites heavier than about a hundredth of a microgram  
(equivalently, larger than about 0.007 centimeters in diameter) could  
cause such damage. <sup>91</sup> There are probably many more micrometeorites in the  
inner solar system, where comets are vaporized by the sun's heat and ~~fall~~  
<sup>disintegrate</sup> ~~to pieces~~ than in the outer solar system where they are still in deep  
freeze. Again a conservative calculation of damage might assume that  
micrometeorites are as abundant far ~~out~~ beyond the orbit of Pluto as they  
are in the vicinity of the Earth. If this <sup>is</sup> ~~were~~ the case, tiny pits destroying  
about ten percent of the record <sup>will</sup> ~~would~~ be accumulated by the time the  
spacecraft had <sup>s</sup> ~~traveled~~ <sup>about a quarter of</sup> ~~about~~ one light year, ~~much less than~~  
the distance to the nearest star. This calculation applies only to the

face of the record facing outwards. <sup>4</sup> Ten percent damage is clearly too much even for an extraterrestrial civilization easily able to do some reasonable interpolation on the missing bits of information. It is for just this reason that the Voyager records are encased in an aluminum cover, 0.08 centimeters (0.03 inches) ~~in~~ thickness. ~~In this case~~ <sup>Accordingly,</sup> only micrometeorites <sup>more massive</sup> ~~heavier~~ than about five micrograms can penetrate the cover, and there are many fewer big micrometeorites than little ones. ~~In this case,~~ <sup>Employing</sup> ~~and with~~ the same conservative assumptions as before, <sup>we calculate that</sup> less than two percent of the record <sup>should</sup> ~~would~~ be micropitted by the time the spacecraft reached <sup>s</sup> a distance of one light year. This corresponds to about 4,000 tiny impacts before it leaves the cloud of cometary debris. Thereafter, in interstellar space, the abundance of micrometeorites should be much less, and the outward face of the record <sup>will</sup> ~~would then~~ degrade at the very slow rate of about 0.02 <sup>of its area</sup> percent for every 50 light years traveled. An additional two percent of damage <sup>will</sup> ~~would~~ not occur until the spacecraft had traveled an additional 5,000 light years, which is one-sixth of the distance between the sun and the center of the Galaxy. It will take the Voyager spacecraft about a hundred million years to traverse such a distance. If Voyager were by chance to enter the planetary system of some other star, similarly endowed with comets and micrometeorites, then the record might acquire as much additional damage on the way in to such a planetary system as it acquired <sup>accidental</sup> here on the way out. But the chance of such an <sup>accidental</sup> entry is very small.



In all of these calculations -- which are <sup>mainly</sup> ~~essentially~~ due to Paul Penzo of the Jet Propulsion Laboratory -- the damage applies only to the outward-facing side of the record. The inward-facing side, protected by the record itself and by the spacecraft, suffers essentially no damage at all. A rough estimate of a billion years for the average lifetime of the record therefore seems reasonably safe. The records were mounted with Side 1 inwards. Therefore <sup>information</sup> all of the pictorial, human and cetacean greetings, and <sup>"The Sounds of Earth"</sup> ~~sound montage~~ (as well as the first third of the music -- from the First Movement of the Second Brandenburg Concerto to the Partita for Unaccompanied Violin) will survive essentially forever.

And where are the Voyager spacecraft <sup>destined</sup> ~~headed~~ toward? Are they likely <sup>under any circumstances</sup> ~~ever~~ to encounter another planetary system? The directions in the sky <sup>toward</sup> which the spacecraft eventually will be headed ~~toward~~ depend very much on the precision of maneuvers near Jupiter, Saturn, and Uranus during the strictly scientific phase of the mission. Voyager <sup>1</sup> ~~1~~ is tentatively planned to arrive at Saturn on November 13, 1980 and to leave the solar system toward a point in the sky with a <sup>δ</sup> ~~declination~~ of 10.1 degrees and a right ascension of 260.0 degrees. It is in the constellation Ophiucus. Voyager <sup>2</sup> ~~2~~, if all goes well, will arrive at Uranus on January 30, 1986, and leave the solar system with a declination of -14.9 degrees and a right ascension of 315.3 degrees, in the direction of the <sup>(L.C.)</sup> ~~Zodiacal~~ constellation Capricornus. This Voyager ~~2~~ <sup>2</sup> direction assumes that the spacecraft will not, as it is currently not

planned to, encounter Neptune on its way out.

Stars have their own, so-called proper, motions. The Voyager spacecraft are moving so slowly that in many tens of thousands of years the stars in the solar neighborhood will have reassorted themselves into quite different positions than the ones <sup>they</sup> ~~we~~ have now. It is a difficult computer task to calculate what stars might by chance be along the Voyager spacecraft trajectories 50,000 or 100,000 years from now. <sup>Mike Helton of the Jet Propulsion Laboratory has</sup> ~~An~~ attempt<sup>ed</sup> to make such a calculation ~~has been performed by Mike Helton of the Jet Propulsion Laboratory.~~ (In particular <sup>he</sup> ~~he~~ calls attention to an obscure star called AC+79 3888, which is now in the constellation of Ursa Minor, <sup>the</sup> the Little Bear, or Little Dipper. It is now 17 light years from the <sup>S</sup>un. But in 40,000 years it will by chance be within three light years of the <sup>S</sup>un, closer than Alpha Centauri<sup>A</sup>. <sup>is now</sup> Within that period Voyager <sup>1</sup> ~~1~~ will come within 1.7 light years of AC+79 3888 and Voyager <sup>2</sup> ~~2~~ within 1.1 light years. Two other candidate stars are DM+21 652 in the constellation Taurus and AC-24 2833<sup>1</sup>183 in the constellation Sagittarius. However, neither Voyager <sup>1</sup> ~~1~~ nor Voyager <sup>2</sup> ~~2~~ will come as close to these stars as to AC+79 3888. <sup>9</sup> Astronomers classify this star as a red dwarf of spectral type M4. It is substantially smaller and cooler than the <sup>S</sup>un. It may also be much older <sup>9</sup> ~~than the sun~~. The nearest M dwarf star which is not a member of a double or multiple star system is called Barnard's <sup>S</sup>Star.

*It is*

about six light years away. Our ability to detect planetary systems around other stars is at present extremely limited, although it is rapidly improving. Some preliminary evidence suggests that there are one or more planets, of about the mass of Jupiter and Saturn, orbiting Barnard's star, and general theoretical considerations suggest that planets ought to be ~~at least~~ a frequent complement of most such stars.

*71*

If future studies of AC+79 3888 demonstrate that it indeed has a planetary system, then we might wish to do something to beat the odds of the ~~awful~~ *haunting* and *dreadful* emptiness of space -- the near certainty that left to ~~itself~~ *themselves* neither Voyager spacecraft would ever plummet into the (interior planet-rich) ~~region~~ of another solar system. For it might be possible -- after the Voyager scientific missions are completed -- to make one final firing of the onboard rocket propulsion system and re-direct the spacecraft as closely as we possibly can, so that they will make a true encounter with AC+79 3888. If such a maneuver can be effected, then some 60,000 years from now one or two tiny hurtling messengers from the strange and distant planet Earth may penetrate into the planetary system ~~if such there be~~ of AC+79 3888. Since this star is much older than the Sun, it may be that intelligent life ~~has~~ evolved there long ago, ~~and that the information supplied on the Voyager record is almost entirely redundant.~~ But the evolution of intelligence does not proceed *at* a uniform pace. Perhaps in 60,000 years intelligence and technical civilizations will have only recently emerged on a planet of this system. The inhabitants will, of course, be deeply interested



in the <sup>S</sup>un, their nearest star, and its retinue of planets. What an astonishing finding the Voyager record, this gift from the skies, would then represent! <sup>19</sup> They would wonder about us. They would know that 60,000 years is a long period of time in the history of civilizations. They would recognize the tentativeness of our <sup>society</sup> ~~civilization~~, its tenuous acquaintance with technology and wisdom together. Had we destroyed ourselves or had we gone on to greater things? Some of the <sup>Voyager</sup> ~~music~~ <sup>intentionally</sup> expresses a kind of cosmic loneliness, which would perhaps communicate itself across the expanse of light years and the differences in evolutionary histories. We, too, were <sup>time-capsuling,</sup> searching the skies and seeking another civilization with which to communicate. <sup>H</sup> But one thing would be clear about us: No one sends such a message on such a journey, to other ~~for future times~~ worlds and beings, without a positive passion for the future. ~~One thing they could be sure about us,~~ <sup>F</sup> For all the possible vagaries of the message, ~~they could be sure~~ <sup>they could be sure</sup> ~~is~~ that we were a species endowed with hope and perseverance, at least a little intelligence, substantial generosity, and a <sup>palpable</sup> ~~positive~~ zest to make contact with the cosmos.

[Anne Freedgood: Might we consider putting the discussion of the survival of the record in these last paragraphs on its ultimate destination as an epilogue to the book?]

whether to include music performed by alleged Nazi sympathizers; whether to include music performed by Pablo Casals, whose spirit we very much admired but whose records were of poor quality; which version of the Second Brandenburg Concerto to include: the Debussy version, who kindly volunteered their music for the record; Haydn, Vivaldi, Wagner, Tchaikovsky, Schoenberg and Shostakovich; and country and western music, argued to be the music most enjoyed by those who actually put together the nuts and bolts of the spacecraft.

INSERT B - Page 49 of Carl's first chapter: [For Future Times and Beings]

91 Our concern with time <sup>in our sense of</sup> and the Voyager record as a time capsule is expressed in many places on the record -- including greetings in Sumerian <sup>Hittite and</sup> and Kung, photographs of Kalahari Bushmen, music from New Guinea and Australian aborigines, and the inclusion of the composition "Flowing Streams" whose original structure antedates Pythagoras and perhaps goes back to the time of Homer. <sup>Insert \*\* below</sup> In researching "Kinds of Flowers" we came upon a charming and powerful tradition about <sup>it is said,</sup> such Javanese Gamelan music; ~~that~~ There is a kind of <sup>spirit continuously but silently</sup> world music, constantly playing <sup>and that</sup> when a Gamelan orchestra performs, <sup>(in the world)</sup> it is merely making audible the <sup>present moment of the music</sup> composition which has been <sup>of infinity</sup> playing all the time. Perhaps all of the Voyager record can be viewed similarly -- <sup>local and</sup> as a momentary expression of ~~a~~ cosmic discourse, an exchange of greetings and music and information among diverse galactic species <sup>or</sup> which has been in progress for billions of years.

The record itself is, of course, an act of preservation of its musical, pictorial and spoken contents.

Insert \*\*:

The Chinese musicologist Chou Wen Chung had hesitated not one moment in selecting "Flowing Streams" <sup>for Voyager</sup>, from the 5,000 year old tradition of Chinese music <sup>as the single most important piece for inclusion on Voyager.</sup>

Insert D, p 22.

At other times there were long debates on Gregorian chants, Charles Ives, and <sup>Dylan</sup> (would the music stand if the words were incomprehensible?); <sup>Bobby</sup> ~~Dillon~~ whether we should include more than one Bulgarian or Peruvian composition; an Apache lullaby (and the role of Apaches among native Americans); the definition of Near Eastern music; <sup>Furtwangler</sup> the political admissibility of ~~Klemperer~~ and von Karajan. We wanted to <sup>send</sup> include "Here Comes the Sun" by the Beatles, and all four Beatles gave their approval. But the Beatles did not own the copyright,



The accompanying cartoon expresses our heartfelt regret at not being able — primarily for reasons of time and space — to include many of these composers and musicians.

-2-

and the <sup>legal status of the piece</sup> ~~copyright~~ situation seemed too murky to risk. Jon Lomberg was

directly responsible for the inclusion of "Queen of the Night" and the

on both the creative and production sides of the project, Ann Druyan made a host of essential contributions to the Voyager music, and I can't resist quoting one of her

reminiscences: "There's an appliance store on Lexington Avenue in the

Twenties in New York City that is owned by an Indian family. Under a card

table with a madras cloth thrown over it, sits a dusty brown carton with

three unopened copies of Jaat Kahan Ho. Why I want to buy all three occasions

a great deal of animated speculation on the part of the owners. I fly out of the shop and race uptown to listen to it."

"It's a thrilling piece of music. I phone Brown and find myself saying thank you over and over."

Ten years earlier Ann had heard for the first time a movement called "Cavatina" from Beethoven's 13th String Quartet and found herself so moved that then and many times subsequently she wondered how it would ever be possible to repay Beethoven for the experience which he had provided. That debt is at least partly repaid in the Voyager record.

The particular sequencing of compositions which we chose ~~for the Voyager~~ record was <sup>based</sup> ~~done~~ on several different <sup>criteria</sup> ~~grounds~~. We wished to avoid a Western European musical ghetto, and purposely juxtaposed music from many cultures. In some cases pieces are coupled because of the emotional and tone contrast, because of a common solo virtuosity on quite different instruments, or because of a similarity of instruments or rhythmic and melodic styles between seemingly disparate cultures. At one point we considered collecting together the five or six pieces which seemed to us <sup>most</sup> haunting and expressive of a kind of cosmic



loneliness. And indeed the last two compositions, "Dark <sup>V</sup>as the Night" and  
<sup>by</sup> <sup>the</sup> "Cavatina" are distinctly in that category, <sup>and</sup> <sup>they</sup> for us express a  
longing for contact with other beings in the depths of space, a musical  
expression of the principal message of the Voyager record itself.

INSERT FOR CARL'S PORTION OF THE VOYAGER BOOK:

Each record in fact consists of two one-sided copper mothers, each 0.02 inches thick, bonded back to back with a 0.01 inch bonding thickness, so that the total thickness of the record is 0.05 inches. It weighs about 1-1/4 pounds. The record, cover, spider support, and mounting bracket, weighs about 2.4 pounds. The stylus and cartridge are bracketed to the underside of the spider support [CHECK].

Insert A

48  
INSERT FOR CARL'S PORTION OF THE VOYAGER BOOK:

Each record in fact consists of two one-sided copper mothers, each 0.02 inches thick, bonded back to back with a 0.01 inch bonding thickness, so that the total thickness of the record is 0.05 inches. It weighs about 1-1/4 pounds. The record, cover, spider support, and mounting bracket, weighs about 2.4 pounds. The stylus and cartridge are bracketed to the underside of the spider support [CHECK].



Q . p 13  
INSERT FOR CARL'S CHAPTER OF THE VOYAGER BOOK"

H The connection between mathematics and music has been marked at least since the time of Pythagoras. Harmony has a distinct mathematical character and it is a commonplace that mathematicians and theoretical physicists are often also talented in musical composition and performance. Einstein's passion for the violin is no isolated example. But, so far as we can tell, mathematical relationships should be valid for all planets, biologies, cultures, and philosophies. We can imagine a planet with uranium hex<sup>a</sup>fluoride in the atmosphere or a life form which lives mostly off interstellar dust, even if these are extremely unlikely contingencies. But we cannot imagine a civilization for which one and one does not equal two or for which there is an integer interposed between eight and nine. For this reason, simple mathematical relationships may be even better means of communication between diverse species than references to physics and astronomy. ~~For this reason~~

The early part of the pictorial information on the Voyager record is rich in arithmetic, which also provides a kind of dictionary for simple mathematical information contained on later pictures, such as the size of a human being. Because of the relation between music and mathematics, and the anticipated <sup>on</sup>universality<sup>on</sup> of mathematics, it may be that much more than our emotions are conveyed by the musical offerings on the Voyager record.

Some months after the Voyager records were launched into space a science fiction movie called "Close Encounters of the Third Kind" was released, portraying <sup>a</sup> physical rather than radio contact between an advanced extraterrestrial civilization and ourselves. Unlike the Voyager case, the extraterrestrials

are imagined to visit the Earth, rather than a representative of the Earth traversing interstellar space. Despite a credulous acceptance of several stories about unidentified flying objects, the movie had at least one virtue: The initial messages were <sup>naive, but at least</sup> mathematical (showing the geographical coordinates of a future meeting) and musical. Indeed, the climactic scene in the motion picture portrays a kind of fugue between terrestrial and extraterrestrial electronic organs.

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